

Summary of Meeting #7, of RTCA SC-186, Working Group 5 For the Development of a MOPS for UAT

The meeting was held on 25 – 28 September 2001, at the Headquarters of Eurocontrol in Brussels Belgium, hosted by Nikos Fistas. The meeting was called to order at 9 a.m. on 25 September 2001 by Co-Chairman George Ligler. George provided introductory remarks, welcomed all attendees and asked that each one introduce themselves and their organization. The attendees included:

Larry Bachman – JHU – APL	Stan Jones – Mitre CAASD	Azhar Osmanbhoy – Boeing Air Traffic Mtg
Nikos Fistas – Eurocontrol	George Ligler – PMEI	Tom Pagano – FAA Tech Center – ACT-350
Gary Furr – Titan Corp - FAATC – ACT-350	Chris Moody – Mitre CAASD	Ken Staub – Trios Assoc.(supporting FAA)
James Higbie – JHU – APL	Al Muaddi – JHU – APL	Warren Wilson – Mitre Corp.
Richard Jennings FAA (AIR-130)	Vincent Nguyen – FAA AND-510	Gene Wong – FAA – AND-530

- The following Working Group members joined the meeting for various discussions via telephone:
 - Mike Biggs – FAA ASR-200
 - George Cooley – UPS Aviation Technologies
 - James Maynard – UPS Aviation Technologies
 - Tom Mosher – UPS Aviation Technologies
 - Cmdr Richard Weathers, US Navy – JSC J6T
- The Working Group was asked to review and approve the Minutes to Meeting #6. Hearing no objections to the Meeting #6 Summary, the Minutes were approved as published.
- The Working Group discussed future meeting dates and locations. The following table indicates the currently agreed upon meeting dates and places for meetings of RTCA SC-186 Working Group #5.

Dates/Time	Meeting Place
9am Tuesday, 6 Nov to noon Friday, 9 Nov	Location - Officers Club at the Norfolk Naval Station, 1756 Powhatan Street, Norfolk VA 23511-2995 Will require attendees to submit their name and SSN for base access. Travel info and lodging details to be made available on the ADS-B/UAT web site as soon as available
9am Monday, 10 Dec to 4pm Friday, 14 Dec	To be held in conjunction with the SC-186 Plenary at the new RTCA facilities at: 1828 L Street NW, Suite 805, MacIntosh Rm (202-833-9339) WG-5 meets Monday, Tuesday, Friday with Plenary on Wed. & Thurs. Travel info and lodging details are available on the ADS-B/UAT web site
9am Monday, 28 Jan to noon, Friday, 1 Feb	Location TBD – preferably a WARM climate location. Exact plans to be firmed up by November meeting in Norfolk.
9am Monday, 4 March to 4pm, Thursday, 7 March	Location TBD – expected European location, either Brussels or Paris. Exact plans to be firmed up by December meeting in Washington.
9am Monday, 8 April to noon Friday, 12 April	To be held in conjunction with the SC-186 Plenary at the new RTCA facilities at 1828 L Street NW, Suite 805 (202-833-9339) Plenary plans to meet two days with specifics TBD Travel info and lodging details are available on the ADS-B/UAT web site
9am Monday, 29 April to 4pm Friday, 3 May	Hosted at the William J Hughes FAA Technical Center in Atlantic City NJ Travel info and lodging details are available on the ADS-B/UAT web site
9am Monday, 17 June to 4pm Friday, 21 June	To be held in conjunction with the SC-186 Plenary at the new RTCA facilities at: 1828 L Street NW, Suite 805 (202-833-9339) WG-5 to meet Mon, Tues, Wed with Plenary on Thur & Fri. Travel info and lodging details are available on the ADS-B/UAT web site

4. Moving to Agenda Item #4, Nikos Fistas indicated that he had briefed the status of Working Group 5 efforts toward the production of the UAT MOPS to the Eurocae Working Group 51. Nikos indicated that he would contact one or more members of WG-51 and inquire as to the possibility of holding a WG-5 meeting at a members facility in, for example, Paris in March 2002. Meeting status will be finalized and reported on, not later than the WG-5 meeting at RTCA in Washington DC, 10 - 14 December 2001.
5. Following Agenda Item 5a, the Working Group began to review the status of Open Action Items. Albert Muaddi presented Working Paper WP-7-11 as the response to Action Item 6-3. The objective of WP-7-11 was to assess the European DME/TACAN interference environment for 978/979 MHz. The approach taken in WP-7-11 was to fly an aircraft over Europe at different altitudes, to plot contours for received power levels from every DME and TACAN, and to evaluate regions where multiple contours intersect to determine worst-case scenarios. Following presentation and Working Group discussions of WP-7-11, the conclusions were shared with Ms Gondo Gulean of Eurocontrol with the objective of developing worst-case DME scenarios for Europe. Discussions continued throughout the meeting and a document detailing a Eurocontrol specified worst-case DME scenarios will be posted after the meeting as Working Paper UAT-WP-7-16. Mike Biggs agreed to continue coordination with Ms Gulean with the objective toward refining UAT-WP-7-16.
6. Albert Muaddi went on with Agenda Item 5a to present Working Paper WP-7-12 in partial response to Action Item 6-4. The conclusion of Working Paper WP-7-12 was that there were no major differences in the CDF of received interference level for Core Europe when JTIDS is added to UAT. In addition to WP-7-12 as a response to Action Item 6-4, Ian Levitt submitted a paper, which the Working Group determined should be assigned as Working Paper UAT-WP-7-14. In WP-7-14, Ian analyzed the impact of JHU-APL supplied interference models and JTIDS timelines identified in Action Item 6-1 in an effort to determine the impact of these timelines on DME operation in light of reply efficiency tests for the four (4) DME units reported on in WP-6-14. Ian concluded that for the 4 DME units identified in WP-6-14, it seems that DME should not suffer any noticeable performance degradation in the presence of UAT.
7. The Working Group initiated a phone call to Mike Biggs and discussed the results of Working Papers WP-7-11 and WP-7-12. Additional discussions with Mike related to preparation of presentations to WG-C at the ICAO meeting in Anchorage Alaska beginning 15 October.
8. The Working Group initiated a phone call to UPS Aviation Technologies and spoke to Tom Mosher with regard to Action Item 6-2, wherein Tom was asked to test the effect of adjacent channel DME on receiver performance of the "Pre-MOPS" UAT boxes. Tom indicated that he had a few problems with the testing, but would provide results later during the week. During the week, Tom initially forwarded via email a set of JPEG files showing results of his testing. As a result of Working Group discussions with Tom regarding the JPEG plots, Tom later provided a document that became Working Paper UAT-WP-7-15 to the Working Group via email. In WP-7-15, Tom concludes that high levels of adjacent channel DME have been shown to have an effect on the prototype UAT receiver output. The effect persists beyond the duration of the DME pulse itself. The effect is reduced by using a narrower receive bandwidth. The cause of the pulse-stretching effect remains to be determined. Some candidates for investigation are charge storage due to saturation of the IF amplifiers, or possibly excessive triple-transit distortion in the receiver SAW filter. Further research into this effect will be carried out if the test evaluation of the pre-MOPS UAT boxes shows that it is

necessary. It is likely that some improvement in performance is possible, but the scope of the effort is not immediately clear.

9. The Working Group then moved on to Agenda Item 5c and asked Larry Bachman to present Working Paper WP-7-10 in response to Action Item 6-1. Larry indicated that WP-7-10 addressed bullets 1 through 5 of Action Item 6-1 and that bullet #6 would be presented at the next meeting. The analysis of bullet #6 of AI-6-1 was later folded into Action Item 7-1 and AI-6-1 will be closed. Larry concluded that for A3 transmissions, the “Nominal” and “B” power options perform equally well in fulfilling MASPS requirements, and power option “A” performs somewhat worse. Further, for A2 transmissions, power option “A” out performs the other two power options, and for A1 transmissions, power option “B” out performs the other two power options. Albert Muaddi and Nikos Fistas were tasked to talk to Gondo Gulean during the meeting and come to an agreement on DME assumptions as input to the next round of simulation runs prior to Meeting #8. Following presentation of WP-7-10, the Working Group discussed power levels and the merits of dropping the A0 class designator, possibly in favor of two power level versions of A1 equipment. The decision of the Working Group was to analyze the next round of simulations before making any further determination on whether or not to keep the A0 class of equipment.

During Working Group discussions on power levels, the Working Group agreed that subject to validation with measurements from the “Pre-MOPS” UAT boxes:

- A0 power will be 38.5 to 42.5 dB (if we agree to keep A0 class)
 - A1 power will be 42 to 46 dB, but we will analyze whether or not we can lower this if the interference is more benign
 - A2 power will be 42 to 46 dB
 - A3 power will be 50 to 54 dB (one final sensitivity analysis with 48 to 52 dB may be run: see Action Item 7-1)
10. As part of Agenda Item 6, Tom Pagano presented Working Paper WP-7-06 with information on transmitter test equipment, and tools available at the WJH FAA Technical Center for consideration for use during the writing of test procedures for this UAT MOPS. WP-7-06 does not relate to any specific Action Item, but was solely for the information of the Working Group. Any comments on WP-7-06 should be directed to Tom Pagano.
 11. Also in conjunction with Agenda Item 6, Chris Moody presented Working Paper WP-7-02 as a summary of UAT Waveform Testing utilizing the “Pre-MOPS” UAT boxes. Following Working Group discussions on activities of JHU-APL, FAA-TC and JSC, a series of agreements were reached with respect to the activities to take place over the next 6 to 8 weeks. Even though some of these activities were agreed to at a later point during the meeting, they are all presented here for consistency in presentation:

Activities between 1 October and 12 October:

- WJH-TC & JHU-APL – perform UAT self interference measurements and simulations and cross check
- JSC – run BER tests versus JTIDS/DME
- JHU-APL/Mitre – develop interim DME model update and provide to Larry ASAP
- George, Larry, Chris, Nikos, Mike – complete write ups of papers for the Alaska meeting

Activities between 15 October and 6 November, Norfolk Meeting #8:

- JHU-APL – run actioned simulations with interim DME update and possibly tweaked JTIDS
- JHU-APL/WJH-TC – assess “Pre-MOPS” self-interference results versus previous model
- JHU-APL – BER tests on self-interference (under way)

- JHU-APL – analyze JSC BER results on JTIDS/DME
- WJH-TC – run co-site tests after sufficient BER tests

Activities between Norfolk meeting #8 and RTCA Meeting #9:

- WJH-TC – run co-site tests using BER test results
- JSC – all interference sources testing – one or two scenarios run by Larry
- JHU-APL – run appropriate runs using updated receiver model, if possible

- Following Agenda Item 5b, Warren Wilson presented Working Paper WP-7-09 in response to Action Item 6-5. Action Item 6-5 asks that a comparison be made between the UAT model implemented by MITRE and the model developed by JHUAPL to establish their compatibility. Specifically, it was requested that figure 9 of UAT-WP-6-09 (MITRE model) be compared with the figure on page 1-11 of the addendum to UAT-WP-6-11 (JHU-APL model). However, it was determined that these two figures are not directly comparable because the scenario in 1-11 includes DME interference and figure 9 does not. Because of this it was decided to compare figure 9 with the figure on page 1-3 of the addendum. The curves on page 1-3 predict the message success probability (MSR) in the LA basin 2020 scenario with self-interference only. One of the curves in figure 9 also predicts basically the same thing, so a direct comparison should be possible. Warren concluded that it seems that the two models are in very good agreement (with the possible exception of differences in antenna patterns), at least in their predictions for the so-called “unloaded” cases. James Higbie expressed a concern over the conclusions of this Working Paper because he wanted Mitre to validate the JHU-APL simulation of JTIDS, but his concerns may be moot because of the testing now being performed on the “Pre-MOPS” UAT boxes.
- The Working Group then agreed to take up Agenda Item 7a with the review of Section 2.2 in Working Paper WP-7-01 by Chris Moody.
- During the brief discussions of Section 2.2, teleconferences were held with UPS Aviation Technologies regarding their opinions and concerns surrounding the suggestion to eliminate the class A0 equipment designation. UPS-AT forwarded a document outlining their concerns and their requests for further simulation runs, which they would like to see prior to making the determination to eliminate class A0. After Working Group discussion, it was agreed that the details of **Action Item 7-1** would include simulations in large part as requested by UPS-AT for presentation at Meeting #8.
- UPS-AT additionally forwarded via email a document that the Working Group agreed to designate as Working Paper UAT-WP-7-13 in which George Cooley and Tom Mosher address the topics of UAT Gain Antenna, Ground Station Sensitivity in response to Action Item 6-7 and a Link Budget Update.
- During the 1st meeting of WG-5, December 18, 2000, the Working Group reviewed the sections of the proposed UAT MOPS and worked through the identification of individuals and organizations that would be responsible for writing drafts of those sections. The following table is the result of the assignments of those writing actions, updated with the most current versions of any draft section that are available for review during this meeting. The asterisk (*) beside a name indicates the lead person or organization.

Currently available Sections of the Draft UAT MOPS

File Names	Dated	Description	Responsibility
Sec_1a.pdf	3/27/01	Draft 1 of Section 1 – Introduction	Bill Flathers * Jerry Anderson
Sec_2-1c.pdf	9/21/01	Draft 3 of the General Requirements	Tom Mosher

File Names	Dated	Description	Responsibility
Sec_2-2e.pdf	9/17/01	Draft 5 of the Equipment Performance Requirements	Chris Moody * Bob Saffell Rich Weathers Jim Maynard JHU-APL (?)
		Section 2.3 – Environmental	Small 2.4 group
		Section 2.4 – Equipment Test Procedures	Tom Pagano * Bob Saffell UPS-AT Chuck LaBerge JHU-APL (?)
		Section 3 – Installed Equipment Performance	
Sec_4c.pdf	6/07/01	Draft 3 of the Equipment Performance Characteristics	Greg Kuehl
App_A4.pdf	10/1/01	Draft 4 of the Glossary and Acronyms	Rich Jennings
App_B2.pdf	7/19/01	Draft 2 of the MASPS Cross Reference Matrix	Greg Kuehl * Jim Maynard Nikos Fistas JHU-APL (?)
		Appendix C – Example ADS-B Message Encoding	Chris Moody + 2.2 Writers
App_D1.pdf	2/14/01	Draft 1 of the UAT Ground Infrastructure	Ed Valovage * Paul Gross
		Appendix E – Aircraft Antenna Characteristics	
		Appendix F – Link Budgets and Scenario Dependent Ranges	Larry Bachman
		Appendix G – Standard Interference Environments	Mike Biggs
App_H1.pdf	9/14/01	Appendix H – Synchronization Processing Information	Warren Wilson
App_I1.pdf	9/17/01	Appendix I – UAT Timing Considerations	Chris Moody

17. The following **Action Items** were identified during the course of this and previous meetings. The asterisk (*) beside a name or organization indicates that they are the lead for the resolution of that Action Item. Actions shown here are those Action Items that remain OPEN.

Action Number	Action Description	Assigned to	Status
3-6	Mike and Gondo to determine criteria for acceptable DME performance in the presence of UAT interference	Mike Biggs Gondo Gulean	Assessed at Meeting. #7
4-3	Run his models on all JTIDS scenarios (9), two 1 MHz offset DME scenarios, and self interference, as appropriate to the JTIDS scenarios, with power levels agreed to at Meeting #3 -- with labeled axes (and no yellow lines) -- for Meeting 8	Stan Jones	
4-14	Establish subparagraphs to section 2.2.5.2.2, and/or notes to the table in section 2.2.5.2.2	Stan Jones Chris Moody (*) Larry Bachman	
5-6	Put old coding into the simulation and run to see if the result is similar to the curves that were presented in the Co-site testing presented by Tom Pagano	Al Muaddi	

Action Number	Action Description	Assigned to	Status
5-16	Accuracy of the time synch availability on various aircraft. What part of the 2.7 microsec is static versus variable?	Chris Moody Stan Jones George Ligler	
6-6	Draft Appendix B.2 on FIS-B MASPS compliance.	George Ligler Chris Moody	
7-1	For Meeting #8, James Higbie and Warren Wilson will provide whatever they can on the effect of high powered DME interference, in support of the simulation runs, to include: 1. Run UPS-AT requested simulation #2 first. If A3 performance is marginal, then there is no need to run with power level for A3 at 48 – 52 dBm. If the results of #2 look as expected by Larry, then the #1 simulation need not be run. However, if it looks OK, then UPS-AT simulation request #1 should be run. Run an excursion on today's DME environment with 978 MHz DMEs removed. 2. Run UPS-AT requested simulation #3, using the A0 from either Run #1 or #2, based on whether or not both runs are made. 3. If possible, run a Probe scenario, to be agreed by Larry, Stan and Chris. 4. Run the LAX2020 with JTIDS Baseline B from WP-4-04, no DME and with Power Levels set as in UPS-AT requested simulation #3, and run a case with the 1.2 MHz filter on the A2 and A3. 5. Model air-ground ATC reception presuming one adjacent channel DME ground station at a separation of 1000 ft. UAT antennae height 30 feet (Stan Jones model); additional excursion presuming 2 dB improvement in ground station receiver sensitivity (-96 at the antenna and the antenna is 8dB)	Larry Bachman (*) James Higbie Warren Wilson	
7-2	Proposed text for Section 2.2.2.4 [Modulation Accuracy], to be provided at Meeting 8	Tom Pagano Warren Wilson	
7-3	Complete Sections 2.2.3.1.4.2 and 2.2.3.2.4.2 prior to the December meeting and present a draft of Appendix C	Chris Moody John Barrows Ei Mon Phyu	
7-4	Develop for an Appendix, with potential impact on Section 2.2.4, a method of transmitting <u>more than</u> two (2) TCPs for Type A equipment.	Chris Moody Stan Jones (*) Jim Maynard	
7-5	Investigate the performance that can be achieved with a cavity notched filter in the UAT Ground Station at locations with a co-sited 979 MHz TACAN. To be provided to Larry for Action 7-1.	Chris Moody (*) Warren Wilson James Higbie	
7-6	Assessment of existing self-interference model relative to Pre-MOPS units measurement.	Larry Bachman Tom Pagano (*)	

18. The **Working Papers** shown in the following table are specifically for the Meeting being reported in these Meeting Minutes. Working Papers for all WG-5 Meetings, as well as the Meeting Agendas, Meeting Minutes, Meeting Schedules and files leading to the production of a UAT MOPS are posted on the ADS-B UAT web site at: <http://adsb.tc.faa.gov>

Working Paper	Size	Description	Introduced At:
UAT-WP-7-01	78KB	Draft 5 of Section 2.2 of the UAT MOPS, presented by Chris Moody	Meeting 7, 09/25/01 Brussels, Belgium
UAT-WP-7-02	14KB	Summary of UAT Waveform Testing, presented by Chris Moody	Meeting 7, 09/25/01 Brussels, Belgium

Working Paper	Size	Description	Introduced At:
UAT-WP-7-03	20KB	Draft 1 of Appendix I – UAT Timing Requirements, presented by Chris Moody	Meeting 7, 09/25/01 Brussels, Belgium
UAT-WP-7-04	20KB	Separating Data From The Transport in Support of FIS-B Services, presented by Mike Culver	Meeting 7, 09/25/01 Brussels, Belgium
UAT-WP-7-05	54KB	Draft 1 of Appendix H – UAT Synchronization Issues, presented by Warren Wilson	Meeting 7, 09/25/01 Brussels, Belgium
UAT-WP-7-06	132KB	Transmitter Test Equipment, Tools, and Considerations, prepared by Dave Thomas and presented by Tom Pagano	Meeting 7, 09/25/01 Brussels, Belgium
UAT-WP-7-07	20KB	Draft 3 of Section 2.1 of UAT MOPS, presented by Tom Mosher	Meeting 7, 09/25/01 Brussels, Belgium
UAT-WP-7-08	149KB	Draft 3 of Section 2.2.4 of the UAT MOPS, presented by James Maynard and Chris Moody	Meeting 7, 09/25/01 Brussels, Belgium
UAT-WP-7-09	13KB	Comparison of Mitre and JHU-APL Models of UAT in the LAX 2020 Scenario, presented by Warren Wilson, in response to Action Item 6-5	Meeting 7, 09/25/01 Brussels, Belgium
UAT-WP-7-10	1,756KB	Core Europe Results – A Presentation to the UAT MOPS WG-5, presented by Larry Bachman	Meeting 7, 09/25/01 Brussels, Belgium
UAT-WP-7-10-addendum	981KB	Additional slides used as backup for UAT-WP-10, presented by Larry Bachman	Meeting 7, 09/25/01 Brussels, Belgium
UAT-WP-7-11	280KB	An Assessment of the European DME/TACAN Environment, presented by Al Muaddi in response to Action Item 6-3	Meeting 7, 09/25/01 Brussels, Belgium
UAT-WP-7-12	21KB	UAT/JTIDS Interference Against DME, presented by Al Muaddi in response to Action Item 6-4	Meeting 7, 09/25/01 Brussels, Belgium
UAT-WP-7-13	333KB	UAT Gain Antenna, Ground Station Sensitivity, and Link Budget Update, presented by George Cooley and Tom Mosher	Meeting 7, 09/25/01 Brussels, Belgium
UAT-WP-7-14	80KB	Impact of UAT Interference to currently operating DME Equipment, presented by Ian Levitt in response to Action Item 6-4	Meeting 7, 09/25/01 Brussels, Belgium
UAT-WP-7-15	186KB	Notes on DME ACI Figures, presented by Tom Mosher	Meeting 7, 09/25/01 Brussels, Belgium
UAT-WP-7-16	KB	Characterization of the Most Severe Theoretical DME/TACAN Interference Environment, as agreed to during Meeting 7	Meeting 7, 09/25/01 Brussels, Belgium

19. As part of an on-going effort to retain knowledge of items that might otherwise be forgotten, we have created and maintain the following table of “Un-Resolved” or “Orphaned” Issues. This list is reviewed during each meeting and is updated as needed.

Issue #	Issue/Question Description	Raised by	Date Raised	Status
5	Can a minimal installation without an “On Ground” indication continue alternating top and bottom antennas for transmit without significantly sacrificing performance?	Chris Moody UAT-WP-2-06	20 Feb 01	
6	What is the minimum isolation required for antenna switching (20 dB in 1090 MOPS)?	Chris Moody UAT-WP-2-06	20 Feb 01	
10	Whether or not to require an algorithm to determine On-the-Ground status	Section 2.2 discussion	2 May 01	
11	Given that the agreed-upon solution to Coding Selected Altitude appears to add 2 bits, we will remember that we can revisit this issue later if we need to recover those bits.	Discussion on Coding Selected Altitude in WP-4-03	3 May 01	